# Plume Tracker: Interactive Mapping of Atmospheric Plumes via GPU-based Volumetric Ray Casting

PI: Alexander Berk, Spectral Sciences, Inc.

Objective

- Enable real-time quantification of volcanic gaseous and particulate releases from analysis of satellite-based Thermal Infrared (TIR) spectral imagery data.
- Achieve real-time visualization of the impact of changes in model parameters on the fit between observed and model radiance spectra.
- Develop an accelerated implementation of MODTRAN (atmospheric and plume radiative transfer model) TIR radiance algorithms integrated into an interactive toolkit for retrieving and mapping the 3-D composition of atmospheric plumes using JPL retrieval algorithms.
- Achieve at least 100-fold run-time reduction of radiative transfer calculations vs. state-of-the-art MAP_SO2 model.
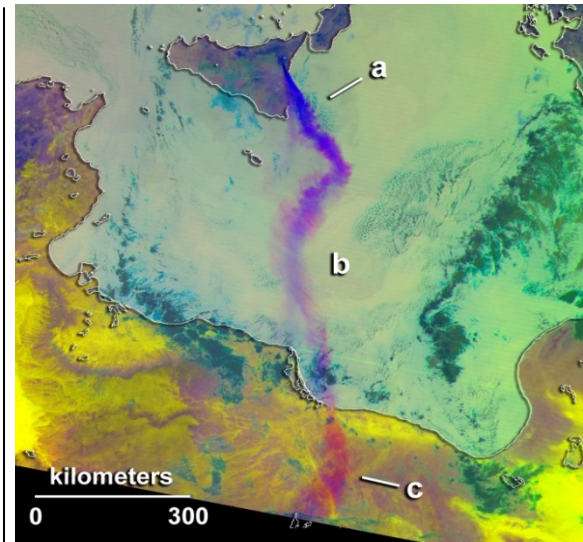
MODIS-Aqua false color image of Mt. Etna eruption plume.

Spectral variations between (a) proximal, (b) mid-range, and (c) distal regions of the plume are due to changes in plume composition and atmospheric and surface conditions.

Accomplishments

- Achieved real-time quantification of volcanic gaseous and particulate releases from analysis of satellite-based TIR spectral imagery data and real-time visualization of the impact of changes in model parameters on the fit between observed and model radiance spectra. Verified accuracy for seven volcanic eruptions.
- Identified trade-offs involved with implementing MODTRAN in GPUs. Identified six other methods by which to achieve faster calculations by removing calculation redundancies and reducing number of MODTRAN runs rather than speeding up individual runs.
- Accelerated MODTRAN (atmospheric and plume radiative transfer model) TIR radiance algorithms using six methods and integrated the algorithms into an interactive toolkit for retrieving and mapping the 3-D composition of atmospheric plumes using JPL retrieval algorithms.
- Achieved 1600-fold run-time reduction of radiative transfer calculations vs. state-of-the-art MAP_SO2 model.

Co-Is/Partners: Vincent Realmuto, JPL; Chona Guiang, Rosemary Kennett, Prabhat Acharya, J. Maxwell Riestenberg, Spectral Sciences, Inc.

TRL_{in} = 2 TRL_{out} = 2

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